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FLUID DAMPER

FIELD OF INVENTION

The inventions relates to a fluidic damper which is used in movable components of a piece of furniture, for example a drawer or a door of wardrobe. It prevents the movable components from shutting with excessive force that would otherwise damage the components and generate undesired noise.

BACKGROUND

A movable component of a piece of furniture such as a drawer of a desk, or a door of a wardrobe generates a loud bang when it slams shut with excessive force. Such noise is distracting and a nuisance. Sometimes, the same piece of furniture may even be damaged as a result of such forceful action. It is, therefore, desirable to shut a door or a drawer in more controller manner.

Previously, this has been accomplished by installing a totally sealed device having a piston to resist the motion of door shutting, but such devices are difficult to adjust in a predictable and controllable way.

Subsequently, European Patent Application EP 1236 925 A2 discloses a damper assembly for the use in connection with drawer slides, and doors for cupboard. The damper assembly comprises a cylinder of uniform bore adapted to receive a piston in a sealing engagement with the bore and to move axially of the bore, the piston being provided with a piston rod in sealing engagement with a bush acting to close one end of the bore, the opposite end being permanently closed. Part of the piston, termed as the piston ring by the inventor, is made of a resiliently deformable material which flattens under compressive force and the same part is pressed against the inner wall of the cylinder to provide frictional force during the inward stoke of the piston into the cylinder. However, the disadvantage of this sort of damper assembly is that the piston ring is highly prone to frictional tear and wear.

A better alternative is to use a hydraulic or fluidic damper. A hydraulic or fluidic damper normally has a cylindrical housing within which a piston is movable in a linear fashion. The same piston is attached to a form of mechanism for providing

resistive force on the piston. The mechanism is usually a cylindrical block or a disc, which spans across the entire cross section of the cylinder with slight spatial allowance between the inner wall of the housing and the peripheral surface of the mechanism. The interior space of the housing is filled with a viscous fluid, so when the mechanism moves within the interior space, it experiences some degree of drag owing to its obstruction against fluid flow from one side of mechanism to another. Unlike the previous damper described earlier, the mechanism is less susceptible to wear and tear since the inner wall of the housing is lubricated with the same viscous fluid that induces the drag force for the mechanism.

However, a conventional fluidic damper is designed to resist motion of both inward and outward stroke of the piston. To cater for the need to resist only motion of the inward stoke of the piston when the drawer is shutting but not the outward stroke, some modification needs to be done to the mechanism. It is precisely the objective of this invention as described in the patent.

SUMMARY OF INVENTION

The invention is a fluidic damper which comprises a closed cylinder containing a valve mechanism. The valve mechanism is attached to a piston rod; a portion of the piston rod emerges through an opening in one end wall of the cylinder.

The valve mechanism comprises:-

- A disc having multiple passages for fluid to flow from one side of the said disc to the other side, and shaft with one or more guide members disposed on the surface of the said shaft at an angle;

- A rotatable annular cover piece which rotates about the said shaft, such that rotation of the cover piece in one direction closes the said openings and in the other direction opens up the openings;

- An annular turning piece, which is structurally connected to the cover piece, having some form of retention mechanism wherein the retention mechanism fits or engages slidingly to the said guide member on the surface of the said shaft, so

that the turning piece rotates when the retention mechanism slides along the guide member;

- A spring disposed between the said turning piece and the said cover piece, to push the turning piece back to its original position and consequently rotates the cover piece (20) to a position that opens up the openings of the said disc (10).

The turning piece is structurally connected to the cover piece by means of claws extending from the cover piece to the said turning piece.

In one embodiment, the guide member is ridge and it fits to a channel on the inner edge of the turning piece. In another embodiment, the guide member is a groove and the retention mechanism is knob extending from the inner surface of the turning piece.

In one embodiment, the shaft is a hollow shaft to receive the piston rod.

In yet another embodiment, the fluidic damper even has an additional spring which connects the closed end of the cylinder to the assembly of valve mechanism and piston rod to help the piston rod to restore to its original position before being depressed.

BRIEF DESCRIPTION OF THE FIGURES

FIGURE 1A shows the different components which are present in the valve mechanism. It consists of an annular disc portion (10) having a hollow tube shaft (15), a cover piece (20), a spring (30) and turning piece (40).

FIGURE 1B shows the different guide member (17A) being a series of grooves which is meant to receive knobs (45A) found along the inner edge of the turning piece (40A).

FIGURE 2A refers to the assembly drawing of the valve mechanism when the spring (30) is uncompressed. The cover piece and the chamfered portions of the annular disc portion, the cover piece and the turning piece are exactly in line with each other, as shown in the front (axial) view.

FIGURE 2B refers to the assembly drawing of the same valve mechanism when the spring (30) is compressed. The cover piece and the chamfered portions of the annular disc portion, the cover piece and the turning piece are totally covered, as shown in the front (axial) view.

FIGURE 2C refers to the assembly drawing of the valve mechanism as depicted in figure 1B when the spring (30) is compressed. The cover piece and the chamfered portions of the annular disc portion, the cover piece and the turning piece are exactly in line with each other, as shown in the front (axial) view.

FIGURE 2D refers to the assembly drawing of the same valve mechanism as depicted in figure 1B when the spring (30) is uncompressed. The cover piece and the chamfered portions of the annular disc portion, the cover piece and the turning piece are totally covered, as shown in the front (axial) view.

FIGURE 3A shows that an embodiment of the damper, which has an additional spring connecting the closed end of the cylinder to the assembly of piston rod and valve mechanism when the piston is fully extended. There is a gap between the annular disc portion and the cover piece. The chamfered portions of the annular disc portion, the cover piece and the turning piece are exactly in line with each other.

FIGURE 3B shows the closing of the gap between the annular disc portion and the cover piece when the piston rod is initially depressed.

FIGURE 3C shows that the chamfered portions of the annular disc portion, the cover piece and the turning piece are slight out of place when the piston rod being depressed at slow speed. This is because the turning piece has moved towards the cover piece slightly, and has rotated at the same time.

FIGURE 3D shows that when the same piston rod is being depressed at faster speed, the turning piece, as well as the cover piece, has rotated more.

FIGURE 3E shows that when the same piston rod is being withdrawn at even faster speed, the chamfered portions of the annular disc portion, the cover piece and the turning piece are totally covered, as shown in figure 2B.

FIGURE 3F shows that when the same piston rod is fully withdrawn into the cylinder, the additional spring is fully compressed. Without further movement of the piston, the chamfered portions of the annular disc portion, the cover piece and the turning piece are back in line with each other once again.

FIGURE 3G shows that the chamfered portions of the annular disc portion, the cover piece and the turning piece remain in line with each other and there is a gap between the disc portion and the cover piece while the additional spring pushes the piston rod back out of the cylinder.

FIGURE 4A shows the different components which are present in the valve mechanism in another embodiment of the present invention.

FIGURE 4B shows the different guide member (17A) being a series of grooves which is meant to receive knobs (45A) found along the inner edge of the turning piece (40A) in another embodiment.

FIGURE 5A refers to the assembly drawing of the valve mechanism of another embodiment when the spring (30) is uncompressed with the openings of the disc portion, the holes of the cover piece and the turning piece are in line with each other.

FIGURE 5B refers to the assembly drawing of FIGURE 5A when the spring (30) is compressed with the openings of the disc portion totally covered.

FIGURE 5C refers to the assembly drawing of the valve mechanism as depicted in figure 4B when the spring (30) is compressed with the openings of the disc portion, the holes of the cover piece and the turning piece are in line with each other.

FIGURE 5D refers to the assembly drawing of the same valve mechanism as depicted in figure 4B when the spring (30) is uncompressed with the openings of the disc portion totally covered.

FIGURE 6A shows that the openings of the annular disc portion, the holes of the cover piece and the turning piece are slight out of place when the piston rod being depressed at slow speed.

FIGURE 6B shows that when the same piston rod is being withdrawn at even faster speed, the openings of the annular disc portion, the holes of the cover piece and the turning piece are totally covered, as shown in figure 5B.

FIGURE 6C shows that when the same piston rod is fully withdrawn into the cylinder, the additional spring is fully compressed and without further movement of the piston, the openings of the annular disc portion, the holes of the cover piece and the turning piece are back in line with each other once again.

FIGURE 7 shows an exploded view of the different components of the valve mechanism of the third embodiment of the invention.

FIGURE 8a shows a cross sectional view of the valve mechanism of another embodiment of the present invention when the spring is uncompressed.

FIGURE 8b shows a cross sectional view of the valve mechanism of figure 7 with the spring in compressed state.

DETAILS OF THE INVENTION

The invention is a fluidic damper which consists of a cylinder (100) having a bore (130) through its longitudinal section for receiving a piston rod (110). One end of the cylinder (100) is closed while a portion of the piston rod (110) emerges through an opening at the other end. The remaining portion of the piston rod (110) lies inside the cylinder (100) and is mounted with a valve mechanism (90). The unoccupied space in the bore (130) is filled with a fluid and the interior of the cylinder (100) is kept fluid tight with a seal (140) flanging the opening.

In one embodiment, the closed end of the cylinder (100) is connected to the assembly of piston rod (110) and valve mechanism (90), with a spring (120). The function of the spring (120) is to push the piston rod (110) back to its fully extended position when the piston rod (110) is not depressed. Alternatively, the external end of the piston rod (110) may be extended to the movable part of the furniture and the piston rod (110), in the case, extends together with the movable part of the furniture without a need of having an additional spring to push the piston rod (110) out of the cylinder bore (130).

The valve mechanism (90) essentially consists of a disc portion (10), and an annular cover piece (20) that turns about the axis joining the center of the two when the valve mechanism (90) exceeds certain speed in the fluid-filled bore.

The disc portion (10) is placed across the bore (130) inside the cylinder (100) with a surface facing the closed end of the cylinder (100). Preferably, the disc portion (10) should cover up the entire inner across section of the bore (130). In a first embodiment, part of the circular periphery of the disc portion (10) is removed to allow the fluid to escape from one side of the disc portion to the other when the disc portion (10) moves along the bore (130) as shown in figure 1A. In a second embodiment, the disc portion (10) may be punctuated with openings (50) adjacent the circular periphery of the disc portion (10) to create fluid passages as shown in figure 4A. A hollow shaft (15), forming a unitary piece with the said disc portion (10), is disposed on the surface of the said disc which faces the closed end of the cylinder (100) and extends perpendicularly from the said surface. It is used to receive the piston rod (110). The piston rod (110) is retained in placed across the valve mechanism (90) with a pair of retaining means (58) rested against the annular cover piece (20) and the disc portion (10) respectively. In a third embodiment, the valve mechanism (90) is formed with the hollowed section (60) partially formed at the hollow shaft (15) as shown in figure 7.

The hollow shaft (15) for the third embodiment is provided with a locking portion (61) extended from the body of the hollow shaft (10). The hollow shaft (15) and the locking portion (61) forming a unitary piece with the disc portion (10). Adjacent the rear end of the locking portion (61) is formed with a groove (62). A retaining means

(63) in an annular form having an extended lip (64) formed at the inner circumferential rear end of the retaining means (63) is fitted into the groove (62) of the locking portion (61) in the assembled position as shown in figures 8a and 8b. The retaining means (63) having a plurality of extensions (66) extended from the front end. The extensions (66) is used to prevent the annular cover piece (20) and the turning piece (40) from further extending out from the hollow shaft (15) as shown in figure 8a. The retaining means (63) further includes plurality of flanges (65) perpendicularly extended from the body of the retaining means (63) for the spring (120) to be rested thereon when the spring (120) is attached to the locking portion (61).

In order to vary the drag force experienced by the valve mechanism (90), the annular cover piece (20) is used to adjust the area of which the fluid can flow through the disc portion (10). It slips onto hollow shaft (15) and is disposed adjacent to the disc portion (10). At one position, the cover piece (20) will cover the maximum area of which the fluid can flow through, and as a result, the valve mechanism (90) will experience maximum drag force as shown in figures 2B and 5B. However, as the cover piece (20) begins to rotate in a direction, it slowly uncovers the openings. In the same direction, it slowly rotates to another position at which maximum flow of fluid can be achieved. At this position, most openings will be opened. In contrast, if the cover piece (20) was to rotate from the position at which maximum flow of fluid through the disc (10) is achieved, in the opposite direction, it would close up the openings again. In the first embodiment, the outer periphery of the cover piece (20) is partially chamfered (27) to match the pattern of fluid passages of the disc portion (10), so as to provide a path through which the fluid in the bore (130) can escape as shown in figure 1A. In the second embodiment, a plurality of holes (51) formed through the cover piece (20), whereby the holes (51) are partially aligned with the openings (50) of the disc portion (10) as shown in figure 4A.

The rotation of the cover piece (20) is effected by an annular turning piece (40) which is structurally connected to the said cover piece (20) by means of withholding claws (25) extending from the cover piece (20). In the first embodiment, the outer circular periphery of the turning piece (40) is also partially chamfered (47) and it is placed between the cover piece (20) and the closed end of the cylinder (100) as shown in

figure 2A. In the second embodiment, the turning piece (40) is formed without the chamfered as shown in figures 4A and 4B.

The turning piece (40) is designed to rotate when it slides along the hollow shaft (15). This is accomplished by having a guide member (17) on the external surface of the hollow shaft (15) as shown in figures 1A and 4A. The guide member (17) is slightly angled with respect to the common axis of rotation of both cover (20) and turning piece (40). On the other hand, the turning piece (40) has some form of retention mechanism for holding itself onto the guide member (17) and tracing the path of the guide member (17) on the surface of the hollow shaft (15). The mechanism either fits or engages slidingly to the said guide member (17) without dislodging, and can be integral of the turning piece (40). For example, if the guide member is a ridge (17), the corresponding retention mechanism can be a notch (45) having complementary receiving surface which is formed by depressing the inner surface of the turning piece (40). Alternatively, the guide member could be groove (17A) on the surface of the hollow shaft (15) as shown in figure 1B and 4B. Knob (45A) extending from the inner surface of the turning piece (45A) is able to turn about the hollow shaft (15) as the knob (45A) slides along the groove (17A).

A spring (30) coiling around the hollow shaft (15) of the disc portion (10) is placed in between the cover piece (20) and turning piece (40). When the valve mechanism (90) is stationary, the spring (30) will be fully extended, pushing the turning piece (40) right to the furthest end away from the cover piece (20) as shown in figures 2A, 2C, 5A and 5C. Having withheld by the claws (25) which extend from the cover piece (20), the turning piece (40) is prevented from being expelled out of the hollow shaft (15). A gap (54) exists between the disc portion (10) and the cover piece (20). However, when the external portion of the piston rod (110) is initially depressed, this gap (54) closes up as the disc portion (10) is pushed forward by the piston rod (110). Subsequently, the whole valve mechanism (90) is propelled towards the closed end of the cylinder (100) through the fluid which flows in the opposite direction through the gap between the bore (130) and the outer periphery on disc portion (10) and cover piece (20) as shown in figure 3F. Initially at low speed, the spring (30) between the cover piece (20) and turning piece (40) is able to counter the drag exerted on the turning piece (40) as shown in figures 3C and 6A. However, as the valve mechanism

(90) accelerates, because of the viscosity of the fluid, the drag on the turning piece (40) also increases. The turning piece (40) in advertently experiences significant resistance in motion and hence slows down. Being slower than the cover piece (20), the turning piece (40) compresses the spring (30) against the cover piece (20). As ~~it~~ turning piece (40) moves relatively towards cover piece (20), the cover piece (20), together with the turning piece (40), rotates and restricts the openings through which the fluid can escape as shown in figures 3E and 6B. With less fluid flowing through the gap between the outer wall of the valve mechanism (90) and the inner wall of the bore (130) the valve mechanism (90) experiences stronger resistive force to counter the motion of the piston rod (110) until the piston rod (110) slows down to a certain speed. However, when the entire mechanism (90) moves away from the closed end, the turning piece (40) remains at its original position without turning. The disc portion (10) is fully open (with openings minimally covered) and the piston rod (110) extends with minimum resistance.